FY04 Technical Program Summary

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Vehicle Technology Directorate -
Langley Site
US Army Research Laboratory
at
NASA Langley Research Center
Hampton, VA 23681-0001

The ARL Vehicle Technology Directorate at the Langley Research Center conducts research in two business areas:

Structural Mechanics and
Loads & Dynamics

Program areas funded under these technical competencies include basic (6.1) and applied (6.2) research in Aviation Technology and Ground Vehicle Technology. The following "Table of Contents" outlines the organization of the work packages and individual research projects within this document.

Aviation Loads & Dynamics Research - 6.1 - 61102 / AH66 / VS1015

VS1015.AL05	Aeroelastic Modeling of Advanced Rotor Configurations
VS1015.AL06	High Performance Piezoelectric Actuator Development
VS1015.AL07	Lightweight Multifunctional Structural Components Development
VS1015.AL08	Fuselage Dynamics and Tail Buffet
VS1015.AR01	Structural and Material Characteristics of Biological Morphologies
VS1015.DC01	Crashworthiness of Composite Frames and Floor Sections
VS1015.DR14	Modeling of Thin Membrane Structures

Ground Vehicle Loads & Dynamics Research - 6.1 - 61102 / AH42 / VS1016

VS1016.DC02	Nonlinear Mechanics of Elastomeric and Composite Structures

Aviation Structural Mechanics Technology - 6.2 - 62211 / A47B / VS2011

VS2011.CA02	SARAP Crash Safety Research Program
VS2011.CD01	Damage Initation and Growth Studies in Tailored Laminates
VS2011.IC02	Skin/Stiffener Debonding Analysis Methods
VS2011.IC03	Exploratory Research on Adaptive Sensors for Composite Rotorcraft
VS2011.IC04	Failure of Rigid Foams
VS2011.IF04	Z-pin Reinforcement Analysis
VS2011.IF08	Fatigue Life Methodology of Metallic Rotorcraft Dynamic Components
VS2011.IF11	Impact Damage Resistance & Tolerance of Thin Skin Composite Sandwich Structure
VS2011.IF12	Reliability-Based Design Methods
VS2011.IN01	Composite Thermal Nondestructive Evaluation
VS2011.IN07	SARAP NDE/Reparability Program

Ground Vehicle Structural Mechanics Technology - 6.2 - 62105 / AH84 / VS2012

VS2012.CA01	Research on Ground Combat Vehicles
VS2012.CA02	Buckling - Vibration Interaction
VS2012.CA03	Analysis of Structural Joints for Ground Vehicles
VS2012.CA04	Inflatable Structures
VS2012.CD01	Selective Reinforcement of Aluminum Structures
VS2012.CD02	Multi-Functional Structures
VS2012.IN07	NDE of Composite Structures Using Laser Ultrasonics
VS2012.IN12	NDE of Electrical Wire Insulation Using Ultrasonics

Aviation Loads & Dynamics Technology - 6.2 - 62211 / A47B / VS2015

VS2015.AA02	High-Speed Aeroelastic Research Models
VS2015.AE03	High-Voltage Electrical Systems
VS2015.AL04	Experimental Investigation of Active Twist Rotor Concepts for Vibratory Load Reductio
VS2015.AL05	Analysis and Design of Active Twist Rotor Blades
VS2015.DC08	Innovative Composite Fuselage Design for Improved Crashworthiness
VS2015.DC09	Soft Soil - Water Impact
VS2015.DC11	Crash Simulation of an ATR42 Aircraft
VS2015.DT01	Applications of Structural Tailoring Concepts

Ground Vehicle Loads & Dynamics Technology - 6.2 - 62105 / AH84 / VS2016

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BUSINESS SUBAREA:	6.2		LOADS & DYNAMICS	
PE/PRJ/WP#/WP:	62211	A47B	VS2015	Aviation Loads & Dynamics Technology
DIRECTORATE/DIVISION	Vehicle Technology Directorate		Loads & Dynamics	
POC/PHONE:	Dr. Mark W. Nixon		(757) 864-1231	

THRUST:

Maintain and enhance rotor aeroelastic testing capability for validation of improved analytical prediction methodology for vibration-free rotorcraft.

Provide validated technology improvements in structural dynamics analyses for multi-body kinematics and dynamics to support vehicle loads analysis, vibration reduction, and improve crashworthiness.

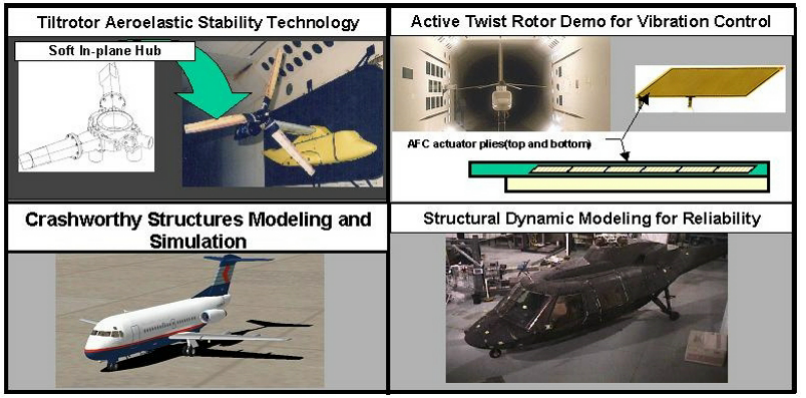
OBJECTIVES:

Develop experimental tools and validate analytical tools to understand and reduce fixed and rotating system vibratory loads.

Evaluate aeromechancial and aeroelastic stability margins for advanced rotor configurations.

Increase the efficiency of airframe structural concepts by using advanced structural tailoring concepts and smart materials.

Reduce the EW/GW ratio of aircraft structures by incorporating technology for crashworthy aircraft into the design process.



PROGRAM SCHEDULE:

RESEARCH STUDIES	2003	2004	2005	2006	2007
High-Speed Aeroelastic Research Models		▪▪▪▪	▪▪▪▪	▪▪▪▪	▪▪▪▪
High-Voltage Electrical Systems		▪▪▪▪	▪▪▪▪	▪▪▪▪	▪▪▪▪
Experimental Investigation of Active Twist Rotor Concep		▪▪▪▪	▪▪▪▪	▪▪▪▪	▪▪▪▪
Analysis and Design of Active Twist Rotor Blades	▪▪▪▪	▪▪▪▪	▪▪▪▪	▪▪▪▪	▪▪▪▪
Innovative Composite Fuselage Design for Improved Cr		▪▪▪▪	▪▪▪▪		
Soft Soil - Water Impact		▪▪▪▪			
Crash Simulation of an ATR42 Aircraft	▪▪▪▪	▪▪▪▪	▪▪▪▪		
Applications of Structural Tailoring Concepts		▪▪▪▪	▪▪▪▪	▪▪▪▪	▪▪▪▪

FY04 KEY DELIVERABLES:

- Perform analytical study to help design improved soft-inplane hubs for tiltrotors.
- Design and initiate fabrication of modifications to SASIP hub to increase damping in forward flight (airplane mode).
- Complete investigation on use of de-ice electronics for piezo-electric actuation devices.
- Complete development and design of Comanche-based advanced active-twist rotor system.
- Fabricate 2nd generation ATR model blades.
- Conduct bench tests of 2nd generation ATR model blades and fine tune analytical model based on gathered data.
- Perform a second vertical drop test of the 1/5-scale model fuselage section to replicate an August 2002 drop test of the full-scale fuselage section.
- Perform analysis modifications for quad tiltrotor design.
- Design and fabricate soft-inplane hub with improved passive damping characteristics in airplane mode.

This chart covers Fiscal Year 2004

Business SUBAREA:	6.2		LOADS & DYNAMICS	
PE/PRJ/WP#/WP:	62211	A47B	VS2015	Aviation Loads & Dynamics Technology

Workyears	2003	2004	2005	2006	2007
ARMY	6.75	5.1	5	4.1	4.1
NASA	1	1	1	.8	.8
OTHER	2.47	3.25	2.2	.6	.6

LOADS & DYNAMICS

OBJECTIVE

The objective of the applied and exploratory technology program in vehicle loads & dynamics addresses validation of analytical methods for prediction of dynamic response - both natural and forced. This research takes the 6.1 program (VS1015) into the application phase for many Army air vehicles. Additionally, the program evaluates the application of new structures concepts in the areas of rotor systems vibratory loads reduction, rotor systems stability enhancement, vehicle systems crashworthiness, and "non-rotating" structural dynamic loads reductions for reliability improvements. These concepts will provide the Army with structurally efficient vehicles in the future.

APPROACH

The applied and exploratory research is conducted through in-house and cooperative efforts with the leveraged NASA facilities and technology relevant to these programs. Principal issues being addressed include: 1) database development of composite crash worthy structures for validation of existing and developing prediction methods, 2) development of advanced rotor blade designs that takes advantage of the unique properties of composite materials deformation under load, 3) validation of advanced design techniques focusing on rotor loads and vibration reduction which include passive and active "smart structures" applications, 4) high-speed rotor concept database development, and 5) enhancements to the Transonic Dynamics Tunnels two experimental rotor systems: Aeroelastic Rotor Experimental System (ARES) and Wing and Rotor Aeroelastic Test System (WRATS) for efficiency and maintainability. Improvements to these model test systems is a continuing process in maintaining a proactive state-of-the-art experimental capability. The Army program is integrated into NASA Langleys Structural Dynamics Branch, and Aeroelasticity Branch. The Langley Transonic Dynamics Tunnel is a unique facility (in the world) that is able to conduct heavy gas modeling at scales large enough for realistic helicopter models and is specifically designed to conduct research in aeroelasticity. The Impact Dynamics Facility is also a unique facility with the capability of testing full-scale aircraft for survivability assessment in crash conditions. These facilities provide substantial leverage within the NASA system to conduct Army specific research in rotorcraft aeroelasticity, loads, vibrations, and structural crashworthiness. All of the researchers involved in these programs are an integral part of the NASA branches and are able to apply the NASAs research programs in fixed wing programs to specific Army interest.Technologies, particularly rotorcraft dynamics, are focused on Rotorcraft Air Vehicles - but are synergistic with new initiatives in Unmanned Air Vehicles.

SIGNIFICANCE

The thrust of this research is to provide technology which enables the intelligent use of composites in future Army vehicles to either provide for lower weight, or improve the vehicles performance benefits beyond what can be realized with conventional structural concepts. The ultimate payoff of these joint Army/NASA 6.2 technology programs will be validated and proven analytical tools to reduce risk in the initial design of configurations of interest to the Army using advanced structures technology, and thereby reducing O&S costs of Army air vehicles. DOD Technology Objectives supported include Demonstration of Advanced Rotor Concepts (DARC), and Rotary Wing Structures Technologies (RWST).The funding in this workpackage directly supports four AMCOM STOs: ARCAT (FY97-FY00), VGART (FY99-FY01), LCAR (FY02-FY04), RWST (FY97-FY01), and SARAP (FY02-FY05).